US008613528B2

(12) **United States Patent**
Marquardt et al.

(10) **Patent No.: US 8,613,528 B2**
(45) **Date of Patent: Dec. 24, 2013**

(54) **LIGHT FIXTURES COMPRISING AN ENCLOSURE AND A HEAT SINK**

(75) Inventors: **Craig Eugene Marquardt**, Covington, GA (US); **Jie Chen**, Snellville, GA (US); **Seun Ilenbiluan**, Conyers, GA (US); **Jeffery Allen Watson**, Covington, GA (US); **Daniel Edward Sicking**, Lawrenceville, GA (US); **Aaron James Becker**, Covington, GA (US); **Mark Anthony Hand**, Covington, GA (US)

(73) Assignee: **ABL IP Holding LLC**, Conyers, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 234 days.

(21) Appl. No.: **13/102,767**

(22) Filed: **May 6, 2011**
(Under 37 CFR 1.47)

(65) **Prior Publication Data**

US 2012/0008331 A1 Jan. 12, 2012

Related U.S. Application Data

(60) Provisional application No. 61/332,436, filed on May 7, 2010.

(51) **Int. Cl.**
F21V 29/00 (2006.01)

(52) **U.S. Cl.**
USPC **362/294**; 362/373; 362/249.02; 362/218; 362/217.11

(58) **Field of Classification Search**
USPC 362/547, 218, 249.02, 294, 373, 217.1, 362/217.11
See application file for complete search history.

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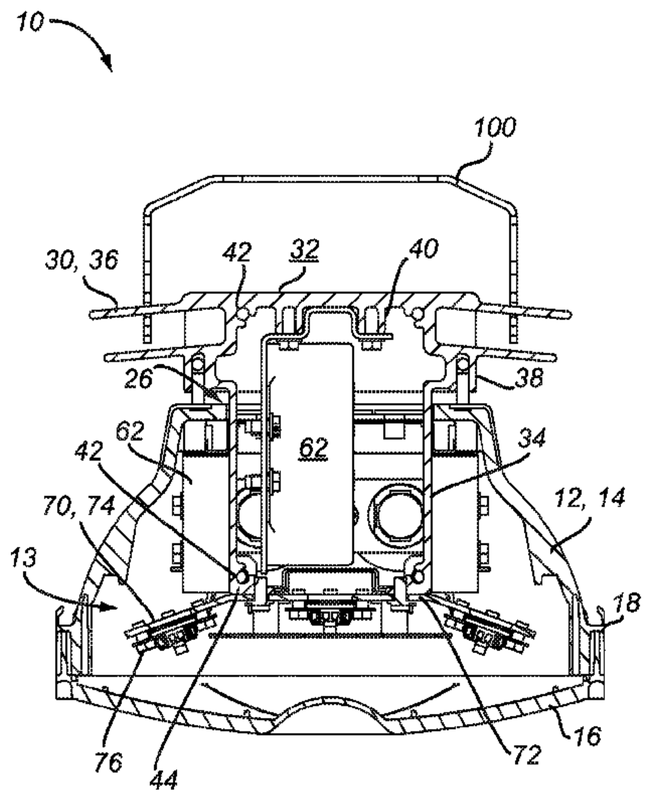
Primary Examiner — Ismael Negron

(74) *Attorney, Agent, or Firm* — Kilpatrick Townsend & Stockton, LLP

(57) **ABSTRACT**

Light fixtures including at least an enclosure, a heat sink, and a light-emitting diode. In one embodiment the heat sink has a first portion having fins (that protrudes outside of the enclosure) and a second portion to house and mount the LEDs (that is positioned within the enclosure). Certain embodiments also provide for gaskets and other structure to prevent leakage between the heat sink and the enclosure, such that the light fixture is water-resistant.

12 Claims, 12 Drawing Sheets



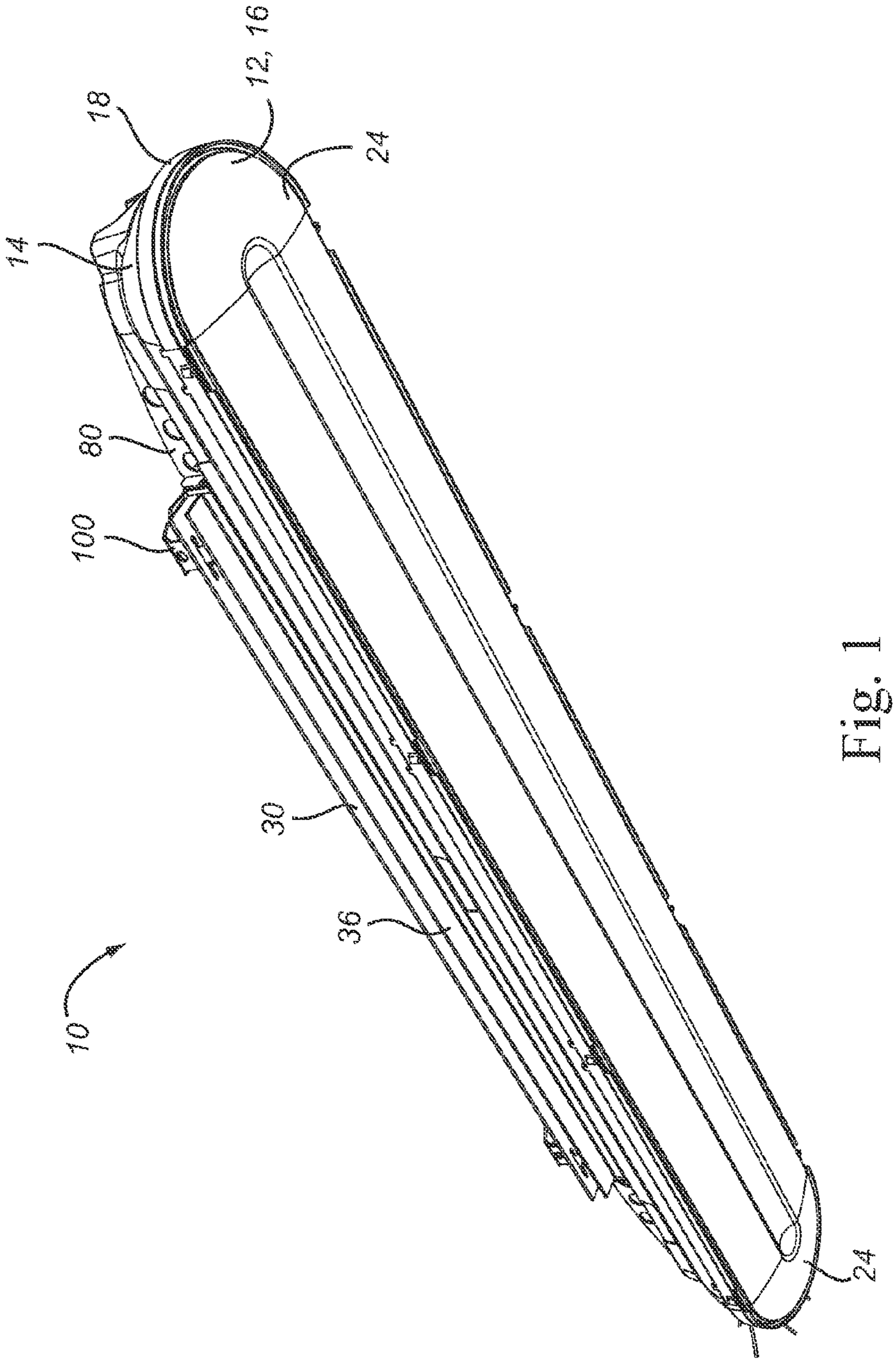


Fig. 1

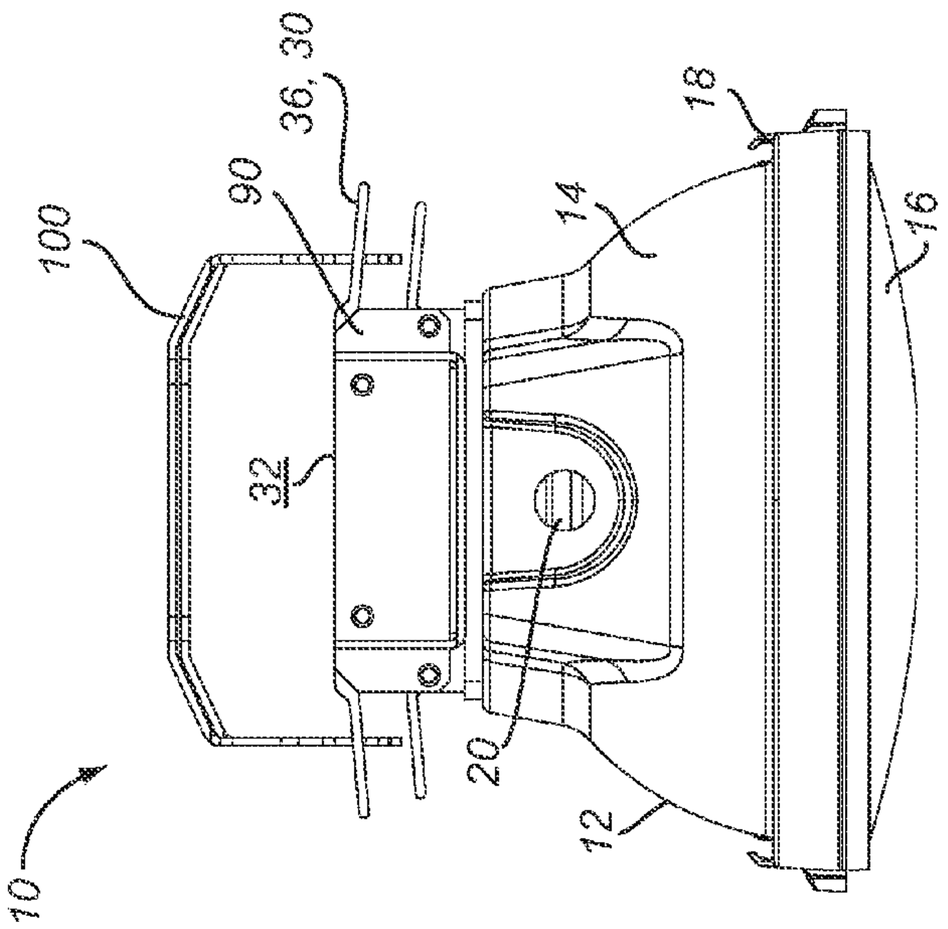

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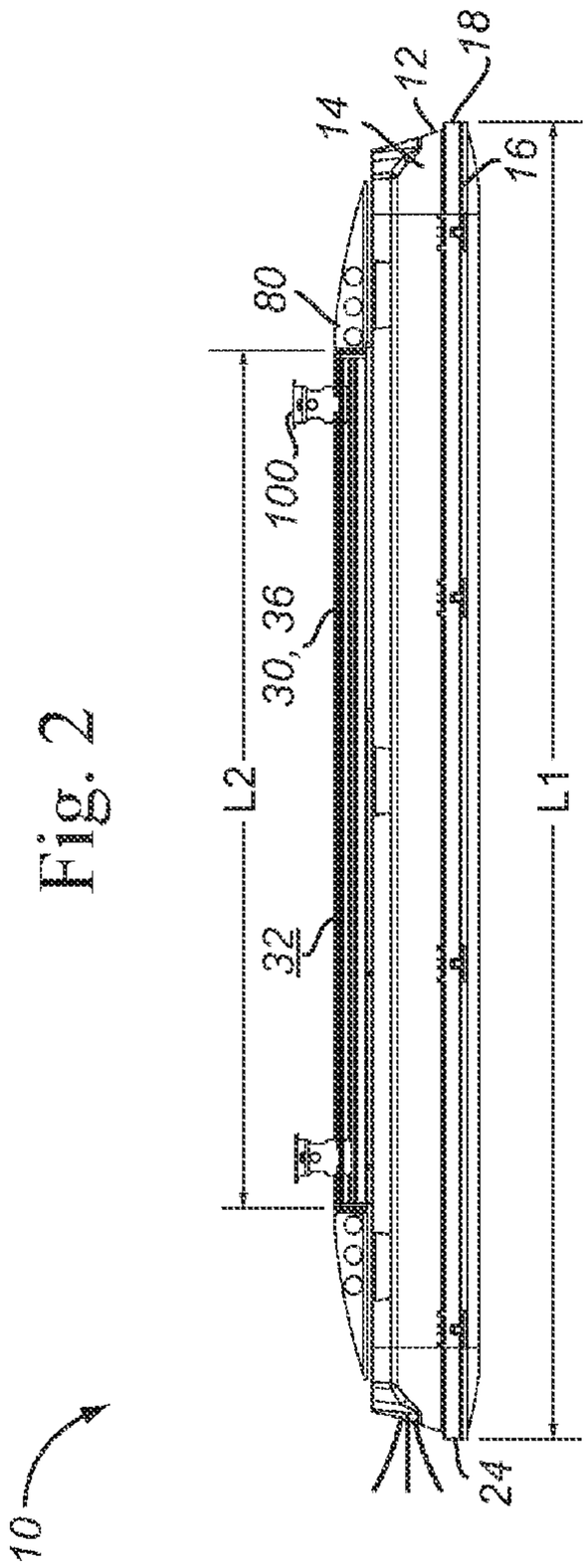
Fig. 2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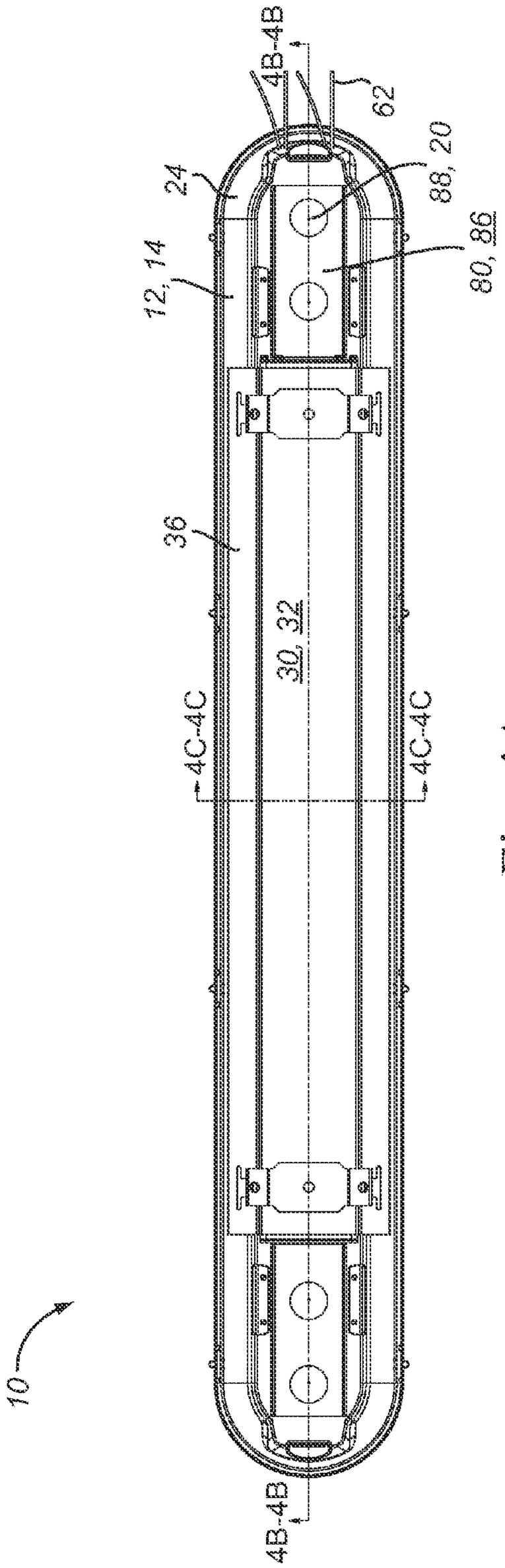
L2
L1
24

Fig. 3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4C-4C
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4B-4B

Fig. 4A

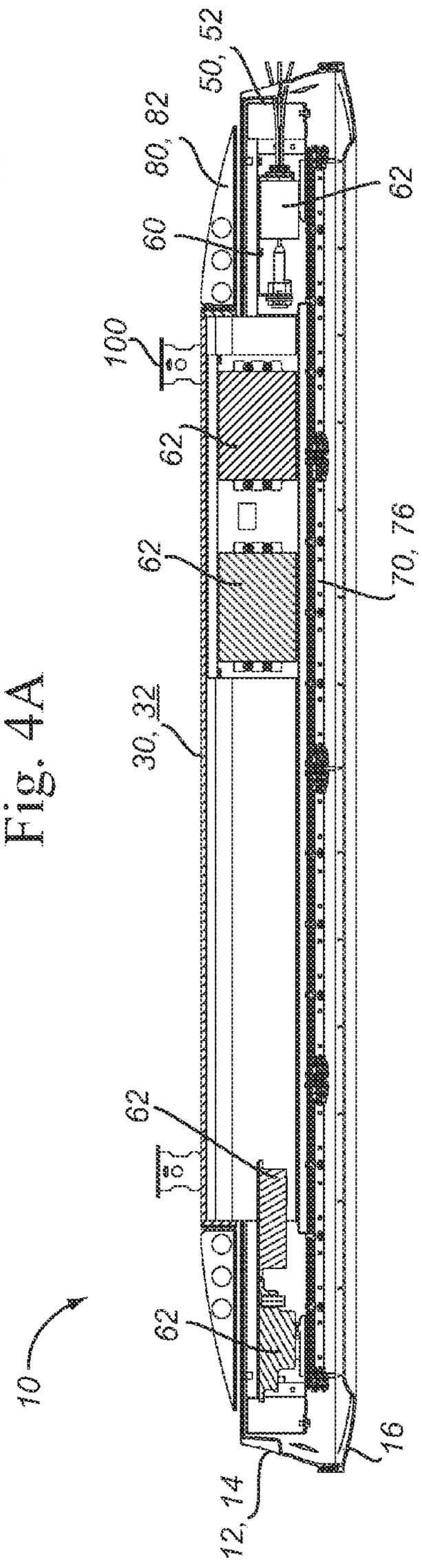
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Fig. 4B

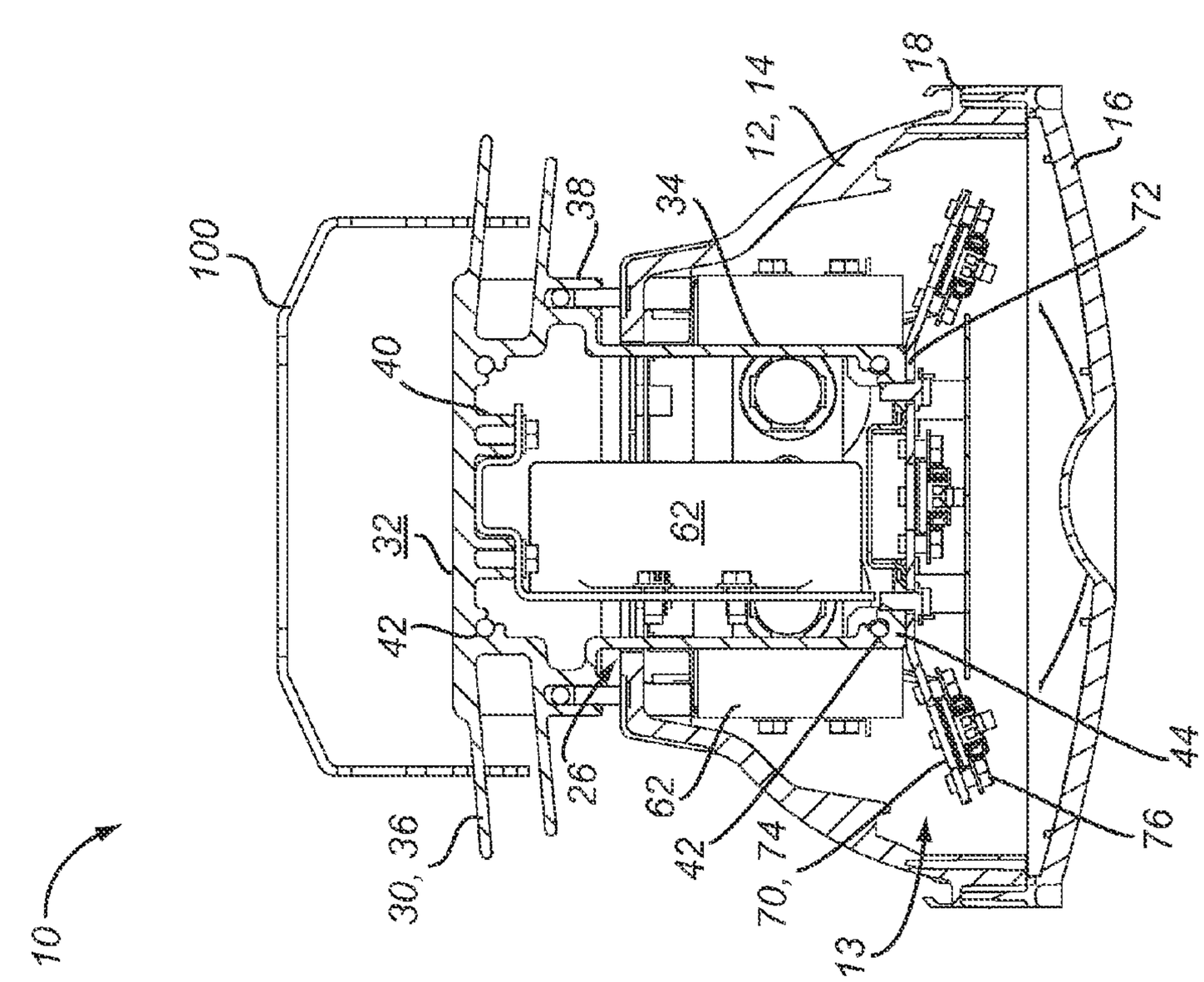

Fig. 4C

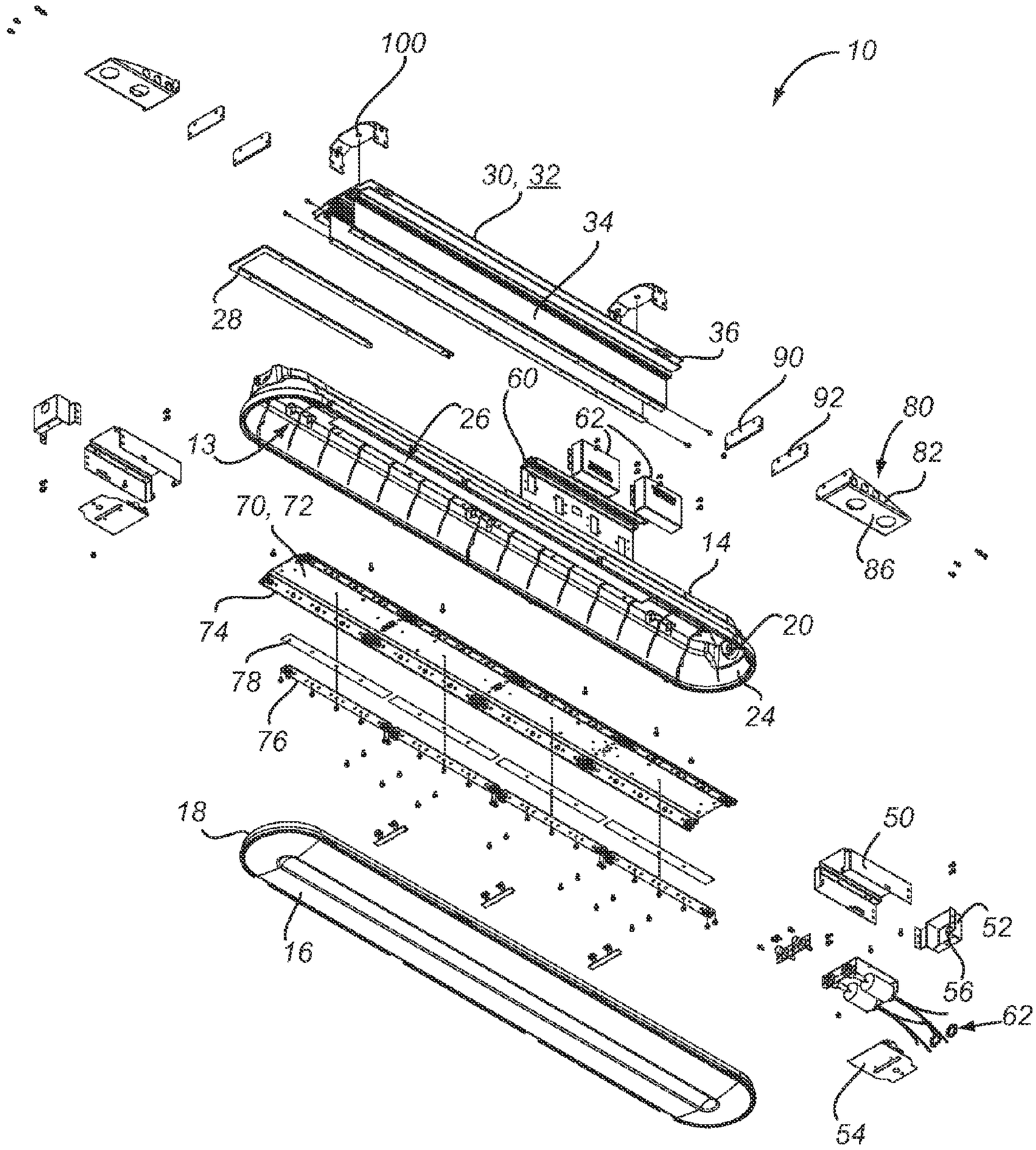
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Fig. 5

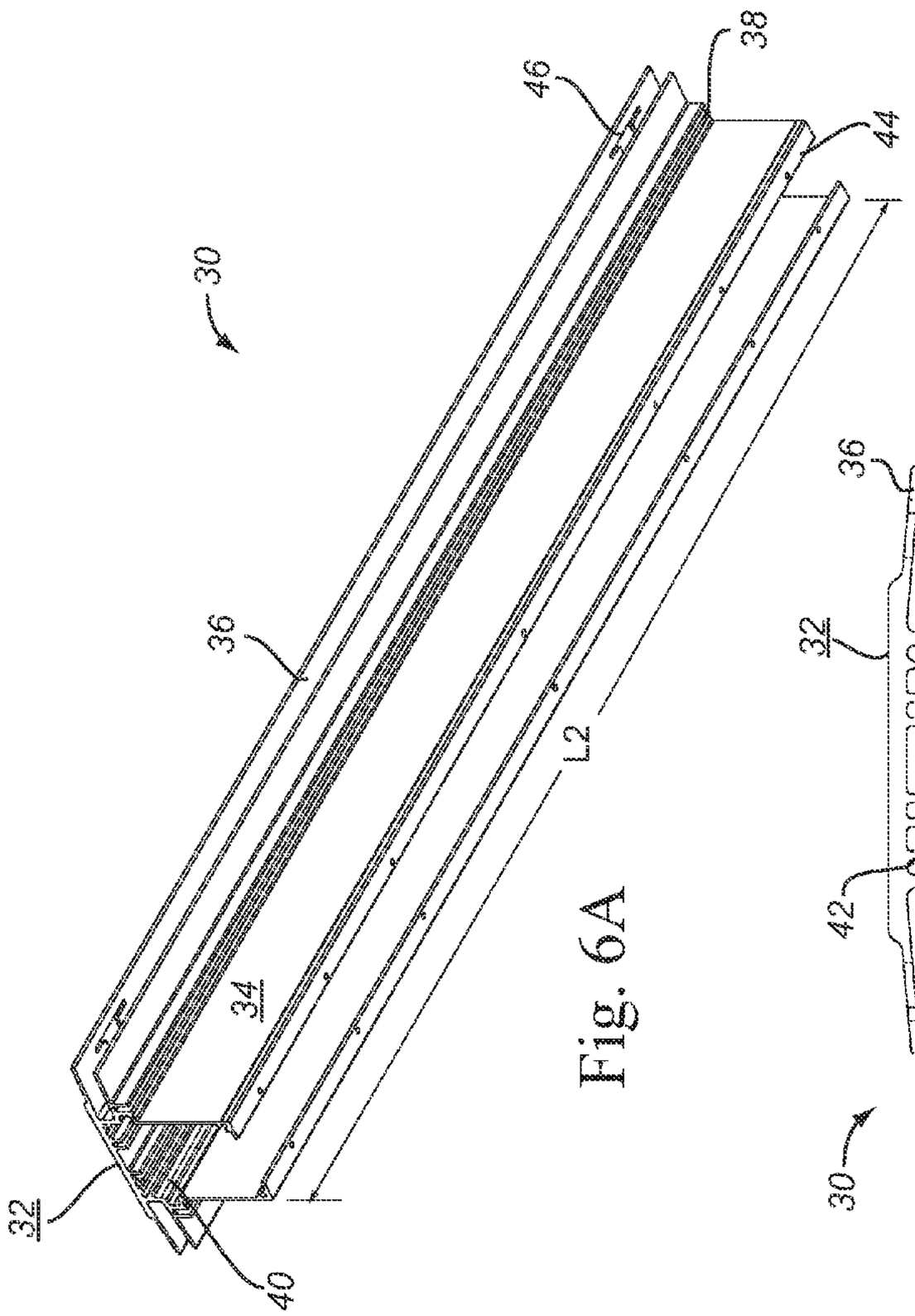

Fig. 6A

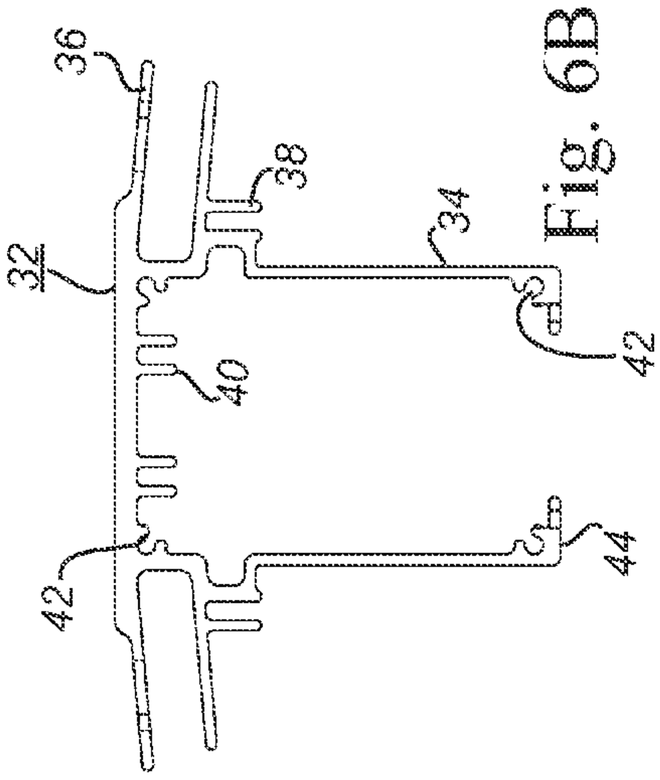

Fig. 6B

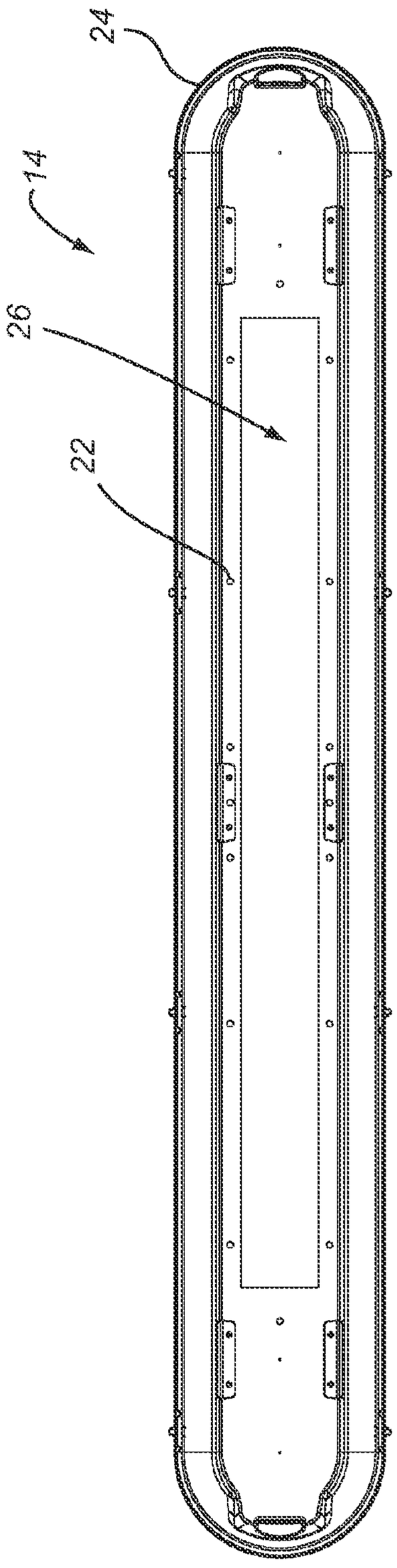

Fig. 7A

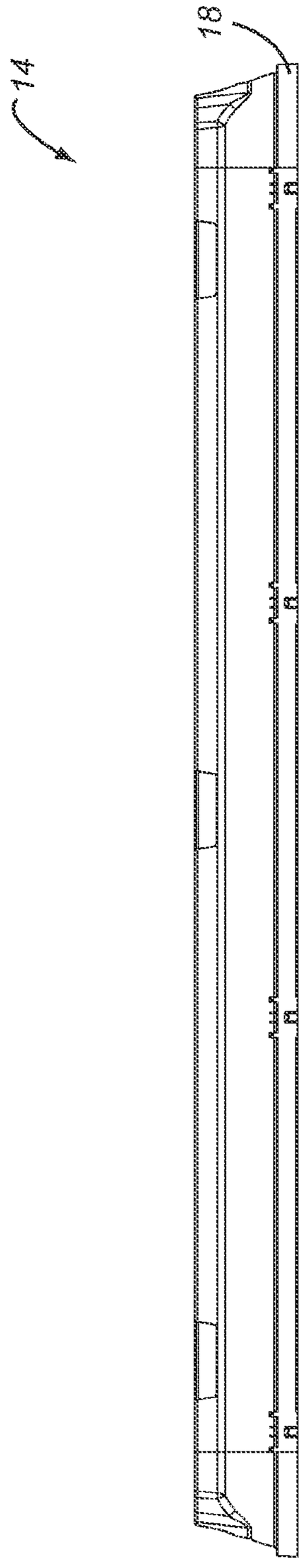

Fig. 7B

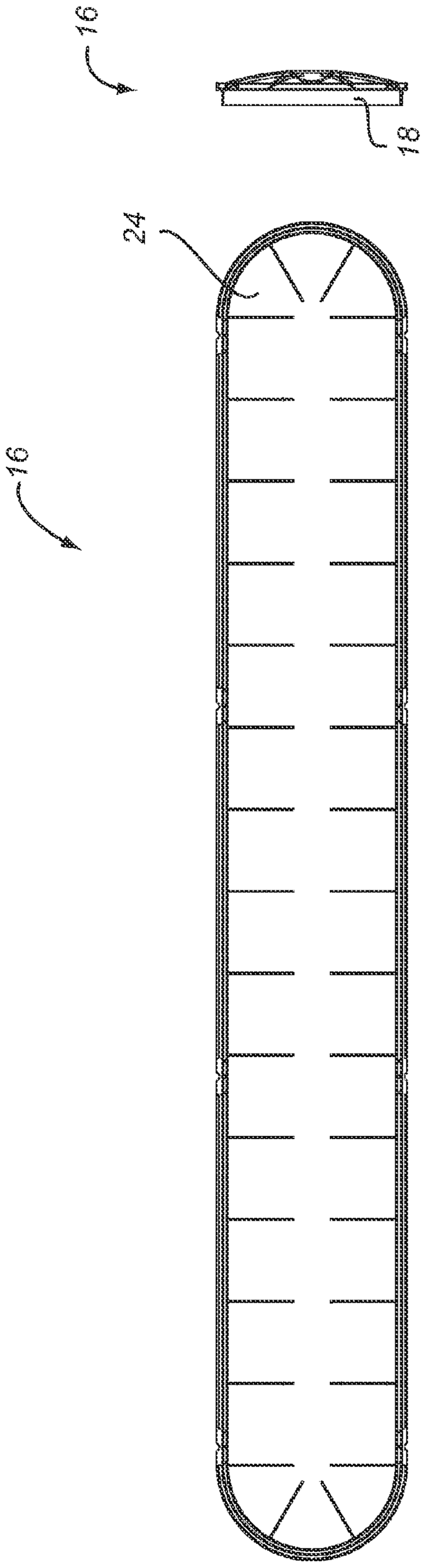

Fig. 8A

Fig. 8B

Fig. 8C

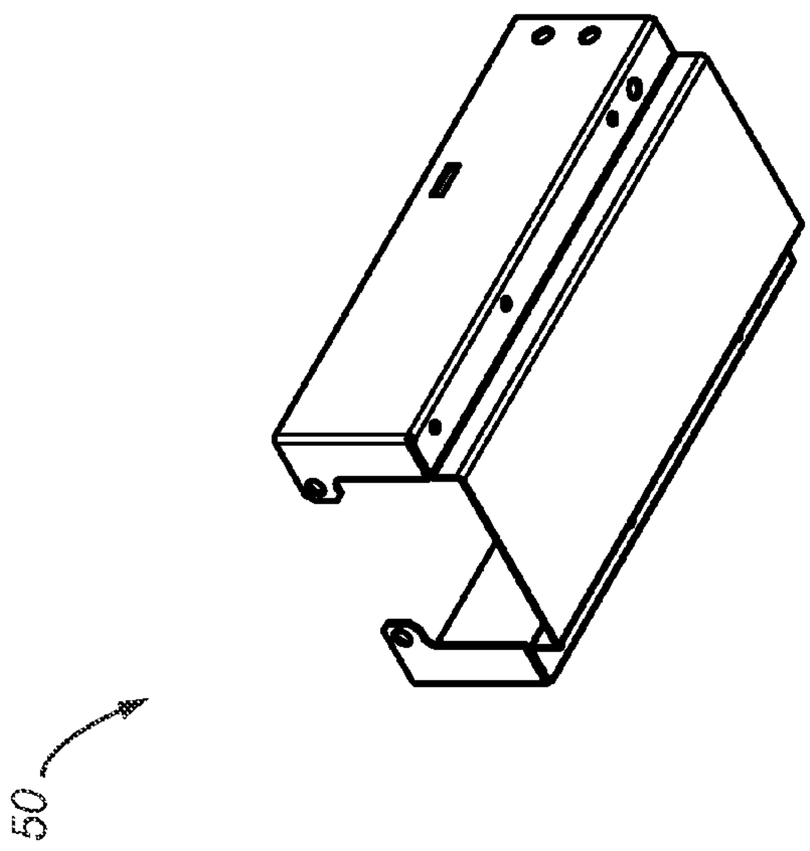

Fig. 9A

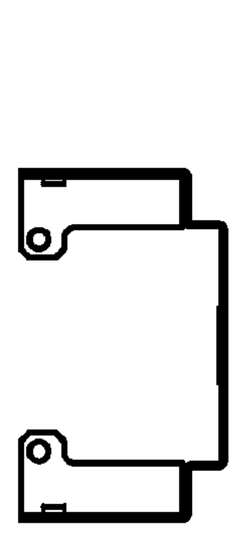

Fig. 9B

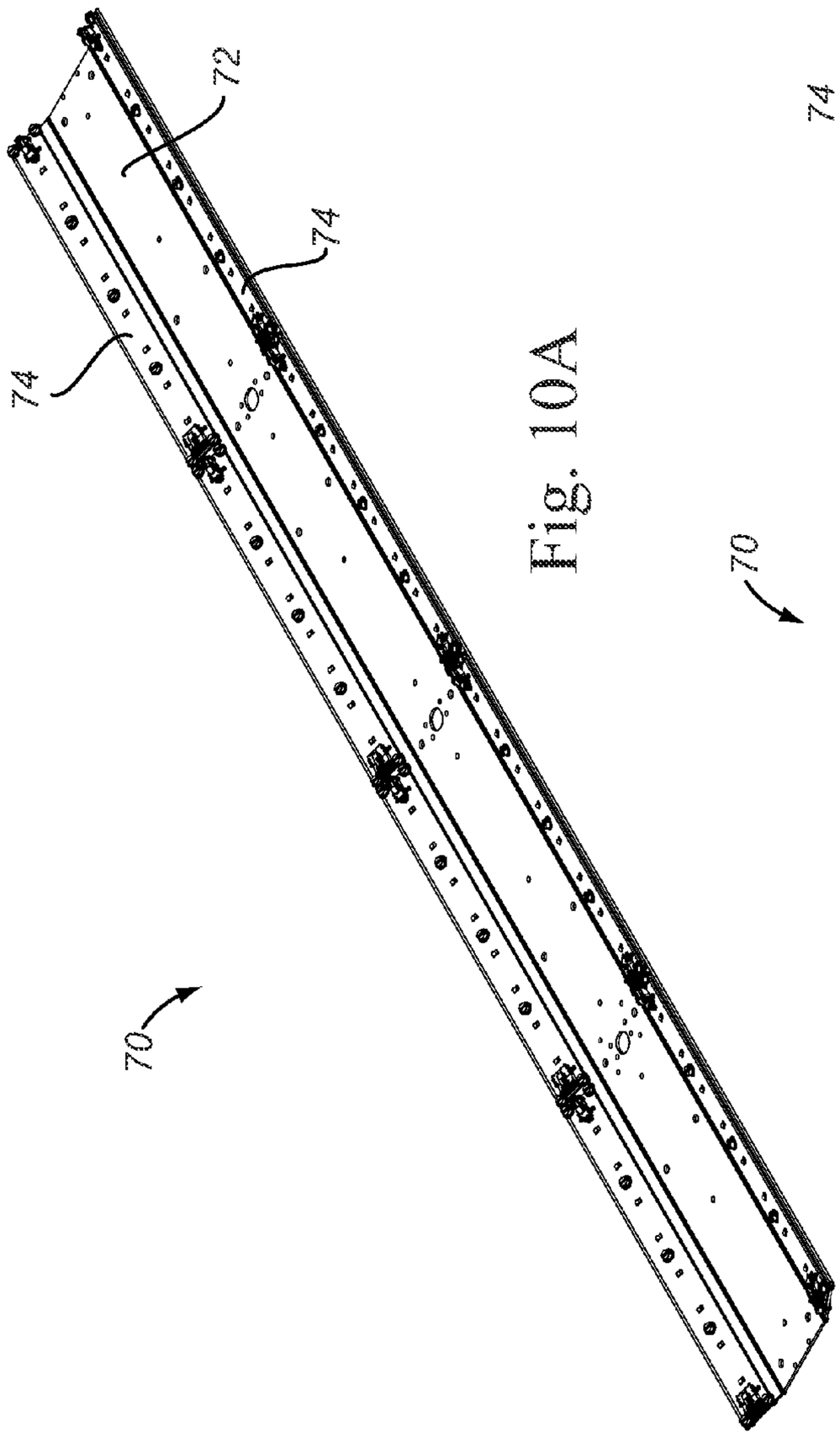

Fig. 10A

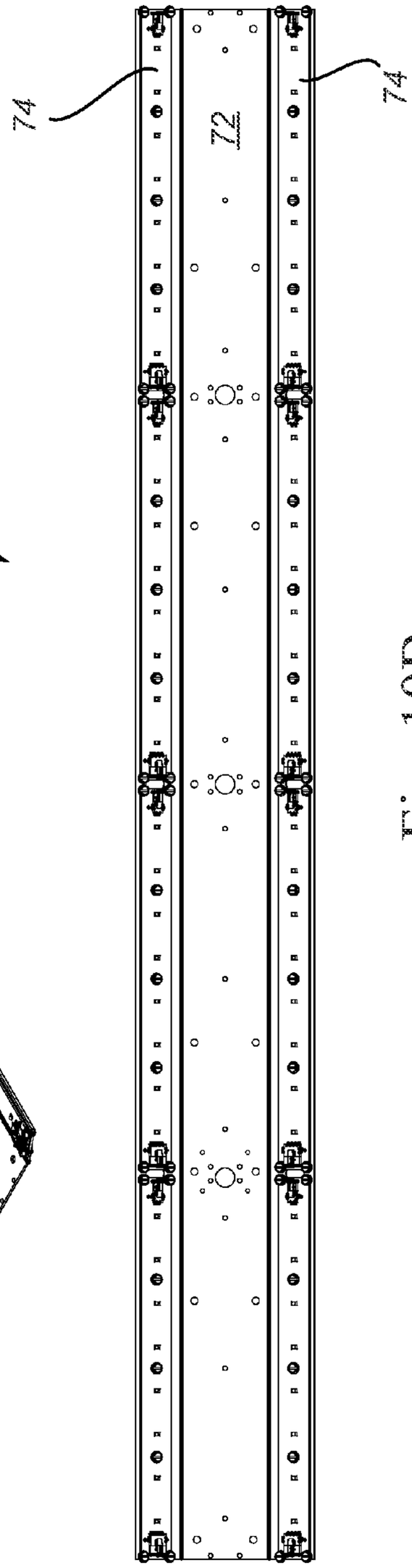

Fig. 10B

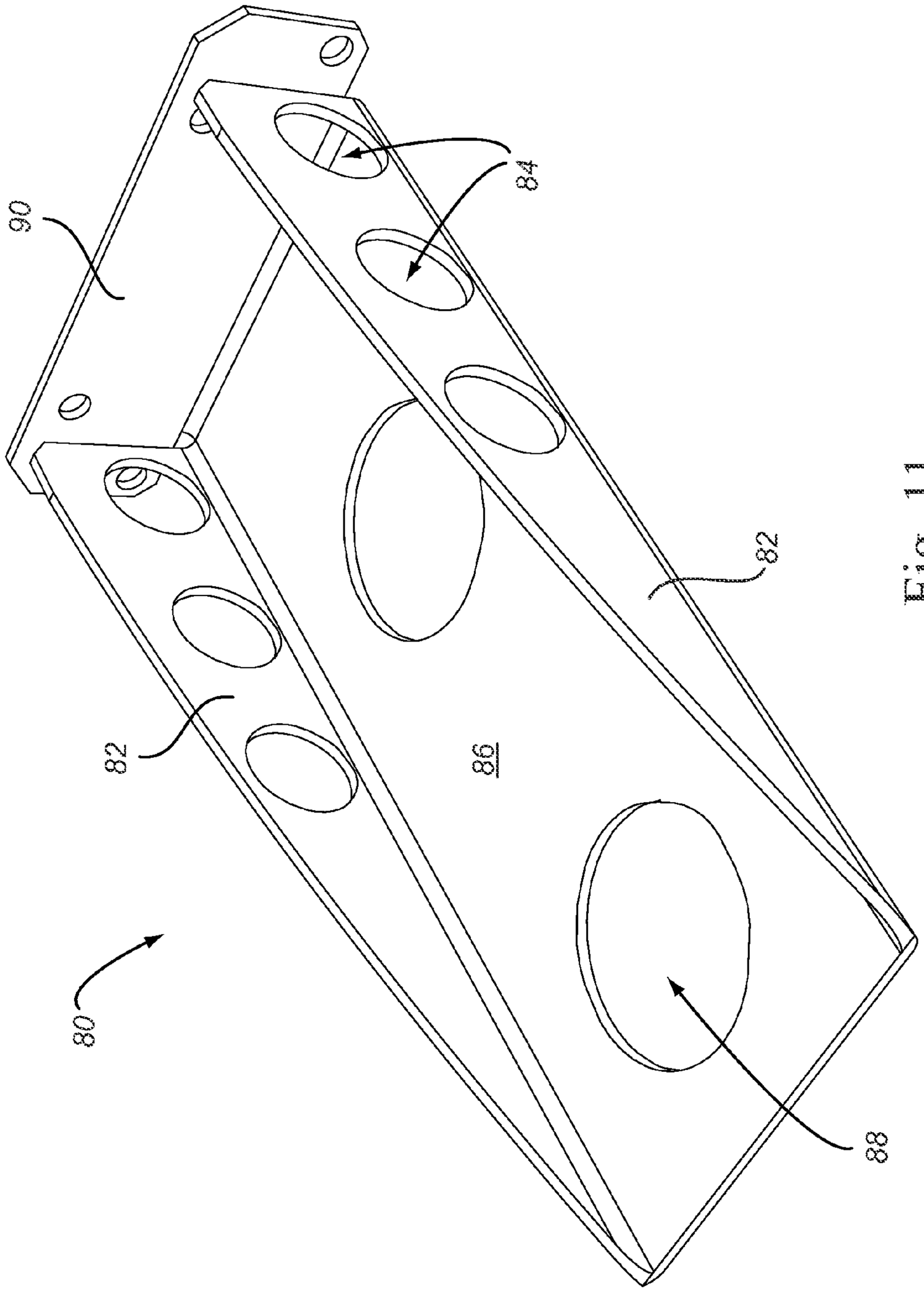

Fig. 11

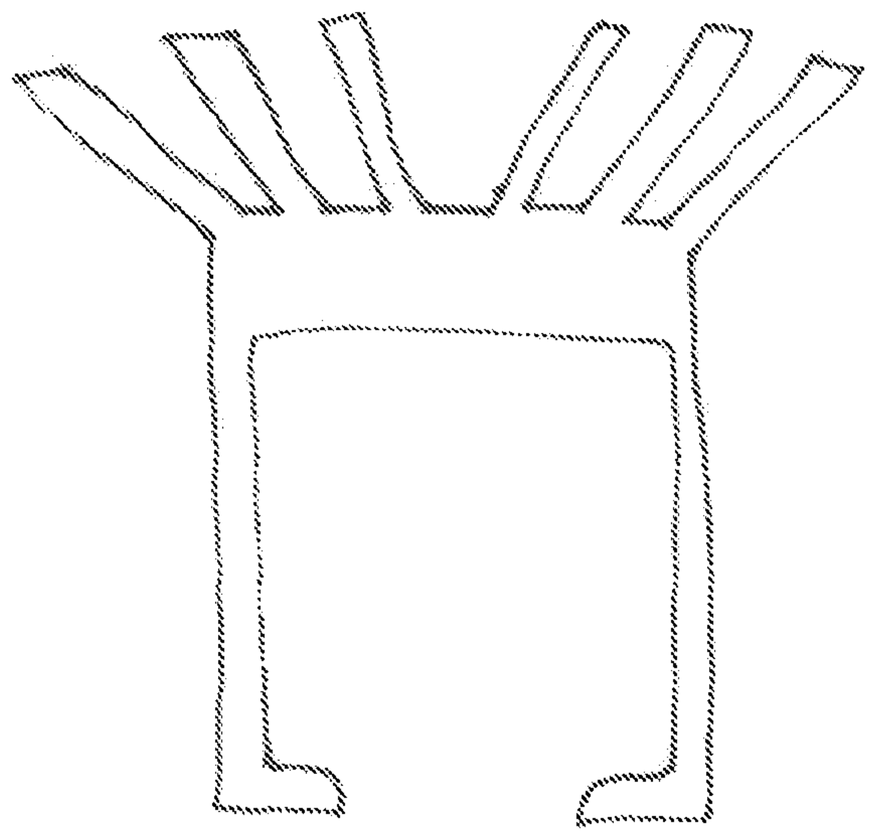

Fig. 12A

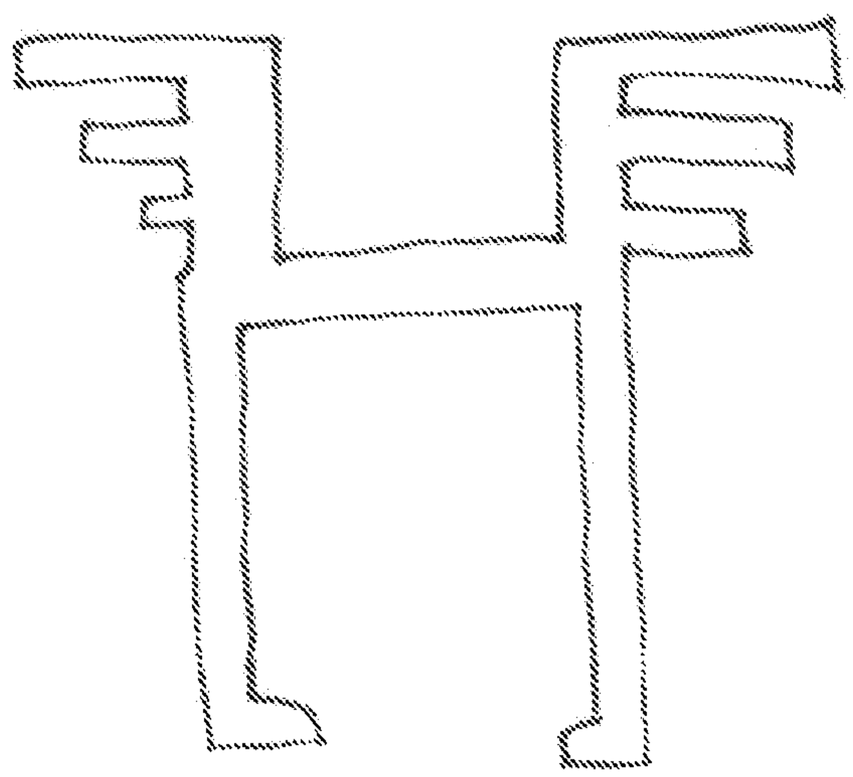

Fig. 12B

LIGHT FIXTURES COMPRISING AN ENCLOSURE AND A HEAT SINK

FIELD

The present subject matter relates generally to light fixtures, and more specifically, to the use of light emitting diodes in a light fixture having an enclosure and a heat sink.

BACKGROUND

An important consideration in the design of light fixtures is selection of the light source. Fluorescent or incandescent lamps have long been the light source of choice in many light fixtures used in commercial applications. But fluorescent and incandescent lamps have drawbacks. For example, fluorescent lamps may result in undesirable lighting that is focused and intensely directed beneath the lamp but dark in areas peripheral to the lamp. Both fluorescent and incandescent lamps require a high level of energy, and thus, are more expensive to operate. Incandescent lamps burn out relatively quickly, which causes material waste. Fluorescent lamps contain mercury, a toxic substance. In general, fluorescent and incandescent lamps are not very "green" or environmentally friendly. Such lamps may also require increased operator time in changing out the lamp when it is burned out.

Another light source that is gaining in popularity is the light-emitting diode, or LED. LEDs might be desirable in certain applications because they generally require less power than fluorescent and incandescent lamps, and they also generate less waste. LEDs last longer, which may be desirable to users who operate the light fixture for long hours and could reduce the frequency of lamp replacements. Finally, LEDs do not contain any toxic mercury.

Despite the fact that it may not be desirable to use fluorescent or incandescent lamps, it may still be desirable to use at least part of the light fixture that was designed to house the fluorescent or incandescent lamp, as long as the special operating characteristics of LEDs are appropriately addressed. Manufacturing equipment and procedures that were used to make the existing enclosure can continue to be used to house the LED boards. Finally, re-using an existing enclosure preserves a consistent look in a room that may already be equipped with light fixtures. (Otherwise, the room may have some light fixtures with new enclosures and some with older ones that look different from one another.)

In general, it may be desirable to re-use at least some parts of a light fixture design (and in particular, an enclosure of a light fixture) to house an LED board or other light source. One problem arises, however, in managing the thermal energy that may be produced by LEDs. One way to manage thermal energy is to incorporate heat sinks into the light fixture. An existing fixture may not be provided with such heat sinks, however, and may not have room to incorporate such heat sinks. Managing the thermal energy may be particularly problematic if the enclosure of the light fixture is made of a material that is insulating, such as plastic, that traps the thermal energy inside the enclosure.

Another problem is that modifications to an existing enclosure may make the light fixture unsuitable for use in particular applications. For example, if the light fixture is to be used in an environment that may be exposed to water, such as a parking garage or other outdoor environment, then it may be desirable to provide a water-resistant light fixture. Modifying an existing enclosure may involve creating apertures in the enclosure, which may introduce water into the light fixture, damaging the components inside.

Thus, it is desirable to re-use parts of an existing light fixture, such as an enclosure, to house LED boards or other light sources.

It is also desirable to manage the thermal energy produced by such LEDs inside the enclosure, particularly if the enclosure is made of plastic.

Finally, if it is necessary to modify the design of an existing enclosure to house an LED board, then it may be desirable for such modifications to be water-resistant.

SUMMARY

Certain embodiments of the invention provide for light fixtures comprising at least a heat sink and an enclosure to be used to house LED boards or other light sources. In one non-limiting embodiment, the heat sink includes a first portion having fins oriented outside of the enclosure and a second portion that extends into the enclosure and couples to an LED mount. The heat sink may be made of a thermally conductive material such that thermal energy is conducted away from the LEDs, into the heat sink, and out of the enclosure. Certain embodiments also provide for gaskets and other structure to prevent leakage between the heat sink and the enclosure, such that the light fixture is water-resistant. Thus, embodiments of the light fixture may house LEDs and related electric components inside a water-resistant enclosure and cool those components by transferring thermal energy (via conductive and/or convective cooling) away from the fixture.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** shows a bottom perspective view of a light fixture according to one embodiment.

FIG. **2** shows an end view of the light fixture in FIG. **1**.

FIG. **3** shows a side elevation view of the light fixture in FIG. **1**.

FIG. **4**A shows a top plan view of the light fixture in FIG. **1**.

FIG. **4**B is a cross-sectional view taken along line **4**B-**4**B of FIG. **4**A.

FIG. **4**C is a cross-sectional view taken along line **4**C-**4**C of FIG. **4**A.

FIG. **5** is an exploded view of the light fixture in FIG. **1**.

FIG. **6**A is a bottom isometric view of an embodiment of a heat sink.

FIG. **6**B is an end elevation view of the heat sink of FIG. **6**A.

FIG. **7**A is a top plan view of an embodiment of the top portion of an enclosure.

FIG. **7**B is a side elevation view of the top portion of FIG. **7**A.

FIG. **8**A is a top plan view of the bottom portion of an enclosure.

FIG. **8**B is a side elevation view of the bottom portion of FIG. **8**A.

FIG. **8**C is an end elevation view of the bottom portion of FIG. **8**A.

FIG. **9**A is an isometric view of an embodiment of a channel

FIG. **9**B is an end elevation view of the channel of FIG. **9**A.

FIG. **10**A is an isometric view of an embodiment of a mounting panel for an LED board.

FIG. **10**B is a top plan view of the mounting panel of FIG. **10**A.

FIG. **11** is an isometric view of an embodiment of a transition piece.

FIG. **12**A is an end view of one alternative embodiment of a heat sink.

FIG. **12**B is an end view of another alternative embodiment of a heat sink.

DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to various and alternative exemplary embodiments and to the accompanying drawings, with like numerals representing substantially identical structural elements. Each example is provided by way of explanation, and not as a limitation. It will be apparent to those skilled in the art that modifications and variations can be made. For instance, features illustrated or described as part of one embodiment may be used on another embodiment to yield a still further embodiment. Thus, it is intended that this disclosure includes modifications and variations.

FIGS. **1-5** illustrate an exemplary embodiment of a light fixture **10**. FIG. **1** shows a bottom perspective view of the fixture **10** as would be seen from below if the fixture **10** was mounted on a ceiling or other structure. The visible components of fixture **10** may include an enclosure **12** that has a top portion **14** and a bottom portion **16**. FIGS. **7** and **8** show more detailed views of the top and bottom portions **14**, **16** of enclosure **12** in isolation. As shown in FIG. **2**, the top portion **14** of enclosure **12** is generally bell-shaped, defining a cavity **13** to house components (e.g., electrical components **62** and LED board **76**) of the fixture **10**. Also, as shown in FIG. **7**A, the top portion **14** may define a cut-out **26** that provides access to the cavity **13** of the top portion **14**, wherein the cut-out **26** may receive a portion of a heat sink **30**, as described below. FIG. **8**A is a top plan view of the bottom portion **16** of enclosure **12**. The surface that is visible in FIG. **8**A would face inward to the cavity **13**; in other words, FIG. **8**A shows the opposite side of the bottom portion **16** as is visible in FIG. **1**. FIG. **8**A shows optional ribs that may be included on the bottom portion **16** for added strength. As shown in FIGS. **8**B and **8**C, the bottom portion **16** is slightly rounded. The bottom portion **16** may serve as a lens to distribute light that is emitted from a light source contained in the fixture **10**. One or both of the top or bottom portions **14**, **16** of enclosure **12** may include a lip **18** with snaps or other structure (such as apertures to receive mechanical fasteners) to couple the top portion **14** to the bottom portion **16**. The enclosure **12** may be of any shape. In the illustrated embodiment, the ends **24** of the top and bottom portions **14**, **16** are curved (as shown in FIG. **1**), and the enclosure **12** has an overall length L**1** (as shown in FIG. **3**).

In some embodiments, the enclosure **12** may have been originally designed for use with a fluorescent or incandescent lamp. The enclosure **12** may be made of plastic such as a polycarbonate, or another material that is thermally insulating. Thus, certain embodiments described herein relate to the modification of enclosure **12** to be used with LEDs, or another light source that may require a heat sink to conduct thermal energy.

One such modification includes coupling of a heat sink **30** with the enclosure **12**. FIGS. **6**A and B show detailed views of an embodiment of a heat sink **30**. In this non-limiting embodiment, the heat sink **30** includes an upper surface **32**, two sets of fins **36** proximate the top of the heat sink **30**, and two sidewalls **34** extending downwardly from a fin within each set of fins **36**. In some embodiments, the two sidewalls **34** are parallel. As best seen in FIG. **4**C, the heat sink **30** is positioned partially within the enclosure **12** and thermally coupled to the LEDs **76** (as described below) to provide a path for conducting heat from the LEDs **76**.

The heat sink **30** has an overall length L**2**. In the embodiment shown in FIG. **6**A, each of the sidewalls **34** and the fins **36** extend the full length of L**2**, but in other embodiments, the sidewalls **34** and/or the fins **36** may be discontinuous or may not extend the full length L**2**. In the particular embodiment shown in FIG. **3**, the length L**1** of the enclosure **12** is greater than the length L**2** of the heat sink **30**. The particular lengths are non-limiting; in other embodiments, the two lengths L**1**, L**2** may be more or less equal to one another.

As shown in FIGS. **4**C and **6**, an end of each sidewall **34** may include a ledge **44** for coupling a mounting panel **70** and LED board **76** to the sidewall **34** of the heat sink **30**. A detailed view of the mounting panel **70** is shown in FIGS. **10**A and **10**B. In certain embodiments, the mounting panel **70** may include a top section **72** and two side sections **74**, each of which are coupled to an LED board **76**. As shown in FIGS. **10**A and **10**B, the mounting panel **70** may also include apertures and other structure for mounting the LED board **76** and other structure. In the embodiment shown in the figures, the side sections **74** are angled such that the LEDs **76** emit light in areas peripheral to the area immediately below the fixture **10**. It is not necessary for the side sections **74** to be angled, however. If desired, a thermal interface material **78** (best shown in the exploded view of FIG. **5**) may be placed between the mounting panel **70** and the LED board **76**. Examples of a thermal interface material **78** include graphite materials, or graphite with polymer additives. Two non-limiting examples are the HITHERM and SPREADERSHIELD products manufactured by the company GrafTech International Holdings Inc., based in Lakewood, Ohio.

The heat sink **30** be made of a thermally conductive material, such as metal, including aluminum, steel, copper, or metal alloys to conduct heat away from the LED board **76**. Additionally, and as shown in FIG. **4**C, fins **36** on the heat sink **30** are located exterior the enclosure **12**. Air flows within the channels formed between the fins **36** to convectively cool the fixture **10**. The particular number and configuration of fins **36** is non-limiting. In the exemplary embodiment shown in FIG. **6**, each set of fins **36** comprises two individual fins that are generally parallel to one another. Additionally, the fins **36** are angled slightly downward with respect to the upper surface **32**, which may be desirable if the fixture **10** is to be used in a wet environment, such that water does not accumulate on the upper surface **32** and can run off of the fins **36**. In other embodiments, such as in FIGS. **12**A and **12**B, there may be more individual fins in each set of fins, or the fins may be non-parallel and/or angled upward. As shown in FIGS. **2** and **3**, at least one fin **36** may define a cut-out **46** to receive a mounting bracket **100** for mounting the fixture to a ceiling or other structure.

Electric components **62** used in powering and operating the fixture **10** may be housed in the space defined between the two sidewalls **34**. For example, the cross-sectional views of FIGS. **4**B and C show an electric component **62** mounted between the sidewalls **34**. Additionally, other structure may be provided to mount to the outer surfaces or ends of the sidewalls **34** to house other electric components **62**. For example, FIG. **5** shows a side bracket **60** that may be mounted to the outer surfaces of the sidewalls **34**. Additional electric components **62** may then be secured between the side bracket **60** and the sidewall **34**. Additionally, a channel **50** (with top plate **54** and end cap **52**) may be provided to mount to the ends of the sidewalls **34**. A detailed view of the channel **50** is shown in FIGS. **9**A and **9**B. The channel **50** may be used to house other electric components **62**. If desired, the end cap **52** of channel **50** may be provided with a drill spot **56** (which aligns with a drill spot **20** provided in top portion **14** of enclosure **12**) that

may be used to access the components **62** if necessary. As used herein, "drill spot" refers to an area of material that is defined by a recessed or indented boundary, such as a circle, that makes the boundary relatively weak such that it can be drilled or cut out to create a hole within the boundary. As shown in FIGS. **4**C and **6**A, inner embossed tabs **40** and channels **42** may be provided within the heat sink **30** to provide a mount for the electric components **62** described herein. Thus, electric components **62** may be housed in the space between the sidewalls **34**, or mounted to the outer surfaces or ends of the sidewalls **34** (with channel **50** or side bracket **60**). The components **62** may include, but are not limited to, surge protectors, fuse holders, LED drivers, or control modules. It may be desired to position the electric components **62** closer to the ends of the heat sink **30** such that the components **62** may be accessed through drill spots **20** defined in the enclosure **12** (shown in FIG. **2**).

As shown in FIG. **4**C, when assembled, the sidewalls **34** of heat sink **30** extend into the cut-out **26** defined in the top portion **14** of enclosure **12**. Inserting the heat sink **30** in an enclosure **12** may require provision of a cut-out **26** in the top portion **14** of the enclosure **12** to receive the heat sink **30**. Outer tabs **38** defined on the heat sink **30** may be used to securely couple the heat sink **30** to the top portion **14** of the enclosure **12**. When assembled, heat generated by the LEDs **76** is conducted away from the LEDs **76** via the heat sink **30**, and air flowing along the fins **36** convectively cool the fixture **10**. If the fixture **10** is to be used in an environment that might be exposed to water (such as rain water in a parking garage), then it may be desirable to provide a gasket **28** (shown in FIG. **5**) between the cut-out **26** of the enclosure **12** and the heat sink **30**. The gasket **28** may help to prevent leakage into the enclosure **12**.

As shown in FIGS. **3** and **4**B, a transition piece **80** may be coupled to one or both of the heat sink **30** or the top portion **14** of enclosure **12** to impart a polished appearance to the fixture. A detailed view of transition piece **80** is shown in FIG. **11**. The transition piece **80** may include structure to prevent water leakage into fixture **10**, and may also be aesthetically pleasing to a viewer. The transition piece **80** may include sidewalls **82**, bottom surface **86**, and end cap **90**. End cap **90** may be mounted to the end of heat sink **30** to cover any openings at the end of heat sink **30**. If desired, a gasket **92** may be mounted between the heat sink **30** and end cap **90** to prevent water leakage. As shown in FIG. **4**A, the bottom surface **86** of transition piece **80** may include drill spots **88** that align with other drill spots **20** of enclosure **12**, and may be used to access the inside of enclosure **12** if needed. The sidewalls **82** of transition piece **80** may be curved to provide a visually aesthetic transition between the heat sink **30** and the enclosure **12**. Additionally, if desired sidewalls **82** may include decorative apertures **84** or other features for even more aesthetic effect.

Finally, mounting brackets **100** may be provided to couple to cut-outs **46** defined in the heat sink **30**. The mounting brackets **100** may be used to mount the fixture **10** to a ceiling or other structure. Any number of mounting brackets **100** may be provided.

The respective components of the light fixture **10** may be made of a variety of materials. For example, in certain embodiments the enclosure **12** is made of plastic such as a polycarbonate. In other embodiments the enclosure **12** may be made of other materials, such as metal. If desired, the enclosure **12** (both top and bottom portions **14**, **16**) may be made using a mold. Additionally, in certain embodiments the heat sink **30**, channel **50**, side bracket **60**, mounting panel **70**, transition piece **80**, and mounting brackets **100** (and any end pieces or plates associated with these components) be made of a thermally conductive material, such as metal, including aluminum, steel, copper, or metal alloys. Some or all of these components may be made with an extrusion manufacturing process. Alternatively, some or all of these components may be made by stamping and folding (for example, stamping the shape of transition piece **80** and then folding it). One of skill in the art would realize that substitutions may be made to either the choice of materials or the manufacturing technique for any of the components of fixture **10**. For example, the heat sink **30** may be made of some other non-metallic conductive material, and may be made with a mold in some embodiments.

While the present subject matter has been described in detail with respect to specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing may readily produce alterations to, variations of, and equivalents to such embodiments. Accordingly, it should be understood that the present disclosure has been presented for purposes of example rather than limitation, and does not preclude inclusion of such modifications, variations and/or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art.

The invention claimed is:

1. A light fixture comprising:

an enclosure comprising a top portion that defines a cavity and a cut-out for providing access to the cavity;

a heat sink comprising an upper surface, at least one set of fins extending from the upper surface, and two sidewalls extending downwardly from the at least one set of fins, wherein the heat sink is coupled to the enclosure such that the set of fins are positioned exterior to the enclosure and at least a portion of the sidewalls are positioned within the cavity of the enclosure;

a light source assembly coupled to at least one sidewall, wherein the light source assembly comprises a mounting panel and at least one light emitting diode, wherein the heat sink conducts heat generated by the at least one light emitting diode away from the at least one light emitting diode and out of the enclosure; and

at least one electric component housed between the sidewalls of the heat sink.

2. A light fixture as in claim **1**, wherein the set of fins comprises at least two individual fins that are parallel to one another, and wherein the set of fins is angled downward from the upper surface of the enclosure.

3. A light fixture as in claim **1**, wherein the enclosure comprises a polycarbonate and the heat sink comprises metal.

4. A light fixture as in claim **1**, wherein the light source assembly further comprises a thermal interface material coupled between the mounting panel and the at least one light emitting diode.

5. A light fixture as in claim **1**, wherein the light fixture is water-resistant.

6. A light fixture as in claim **1**, wherein the enclosure further comprises bottom portion coupled to the top portion.

7. A light fixture as in claim **6**, wherein the bottom portion of the enclosure comprises a lens for refracting light emitted by the at least one light emitting diode.

8. A method of manufacturing a light fixture, the method comprising:

providing an enclosure comprising a top portion and a bottom portion coupled to the top portion to define a cavity;

defining an aperture in the top portion of the enclosure;

providing a heat sink comprising at least one set of fins proximate a top of the heat sink and two opposing sidewalls extending downwardly from the at least one set of fins;

positioning the heat sink within the enclosure such that the at least one set of fins are positioned exterior to the enclosure and at least a portion of the sidewalls are positioned within the cavity of the enclosure;

coupling the heat sink to the enclosure; and

coupling a light source assembly to at least one sidewall, wherein the light source assembly comprises a mounting panel and at least one light emitting diode.

9. A method of manufacturing a light fixture as in claim **8**, further comprising coupling a gasket between the heat sink and the enclosure.

10. A method of manufacturing a light fixture as in claim **8**, further comprising housing at least one electric component between the sidewalls of the heat sink.

11. A method of manufacturing a light fixture as in claim **8**, further comprising coupling a side bracket to a sidewall of the pair of sidewalls; and

coupling an additional electric component between the sidewall and the side bracket.

12. A method of manufacturing a light fixture as in claim **8**, further comprising coupling a transition piece to an end of the heat sink and to the top portion of the enclosure.

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